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EVALUATION OF ENHANCEMENT EFFORTS FOR RAINBOW TROUT, COHO SALMON, AND ARCTIC GRAYLING IN SOUTHCENTRAL ALASKA, 1987[1]

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDIX TABLES

ABSTRACT

Experiments were conducted to provide information for the development of improved stocking practices for hatchery-reared rainbow trout *Salmo gairdneri*, coho salmon *Oncorhynchus kisutch*, and Arctic grayling *Thymallus arcticus* in landlocked lakes. In one set of experiments, the survival and growth of rainbow trout of Swanson River origin were compared with that of rainbow trout of Big Lake origin. In all but one case, the survival of the trout of Swanson River origin was greater than that of trout of Big Lake origin. The mean length at age 1 of the trout of Swanson River origin was variable in comparison to that of the trout of Big Lake origin. In all cases, the growth of the trout of Swanson River origin at age 2+ was similar to that of the trout of Big Lake origin. The relative survival of age 1 Swanson River trout planted as fingerling by the air-drop release method was not significantly different than that of similar fish stocked by the standard hatchery tank truck release method. Based on these findings, we recommend that rainbow trout of Swanson River origin be used for fingerling plants in landlocked lakes via either the standard hatchery tank truck or air-drop release methods.

In another set of experiments the survival and growth of coho salmon, rainbow trout, and Arctic grayling stocked as fingerlings was examined. The mean length of age 1+ coho salmon stocked with rainbow trout in Echo Lake was 185 millimeters. Although it appears that a dual plant of rainbow trout and coho salmon may limit first year fish growth, 80 percent of the coho salmon will be of harvestable size for the winter ice-fishery. The mean length of age 1+ Arctic grayling in Wolf Lake was 134 millimeters, with an estimated survival from stocking of 2.5 percent. This is the second year of poor Arctic grayling survival and growth in Wolf Lake. The mean length of age 1+ rainbow trout in Slipper Lake was 261 millimeters, with an estimated survival of 6.2 percent. Age 1+ Arctic grayling in Slipper Lake had an estimated survival of only 0.9 percent from stocking, with a mean length of 256 millimeters. Based on these findings, we recommend stocking Echo Lake annually with coho salmon and triennially with rainbow trout, stocking Wolf Lake annually with coho salmon, and stocking Slipper Lake annually with catchable rainbow trout.

KEY WORDS: Southcentral Alaska, lake stocking practices, rainbow trout, *Salmo gairdneri*, coho salmon, *Oncorhynchus kisutch*, Arctic grayling, *Thymallus arcticus*, abundance, growth, survival.

INTRODUCTION

Stocked lakes benefit sport anglers and industries related to sport fishing by providing diverse, year-round fishing opportunities and by diverting pressure from natural stocks. In southcentral Alaska, selected landlocked lakes have been stocked on an annual or biennial basis with hatchery-reared game fish since 1952. The majority of these lakes, ranging in size from approximately 3 to 200 surface hectares, were barren or contained only threespine stickleback *Gasterosteus aculeatus* prior to stocking. The lakes are stocked with rainbow trout *Salmo gairdneri*, Arctic grayling *Thymallus arcticus*, or landlocked salmon *Oncorhynchus spp.*, depending on the nature of the water to be stocked, the availability of fish for stocking, and the desires of the angling public for diversified fishing opportunities.

To date, the stocking program has had mixed results. Although contributions to the sport creel have been noted, poor survival of stocked fish have also been observed. One reason for the observed low survivals may be a lack of understanding of the relationship between stocking procedures and the resultant survival and growth of stocked fish. For this reason, it is necessary to evaluate the various stocking procedures being used in terms of their ability to influence the survival of stocked fish. This includes evaluations of brood stocks, stocking densities and sizes, and the timing and magnitudes of stockings.

This report presents findings regarding the effects of brood stock source on the survival of rainbow trout, coho salmon *O. kisutch*, and Arctic grayling in stocked lakes in southcentral Alaska. In addition, findings regarding the effects of release method on the survival of stocked fish are presented. These findings can be used to devise stocking procedures which will maximize the survival of stocked fish in the most cost-efficient manner.

METHODS

Research conducted during 1987 involved the sampling of rainbow trout, coho salmon, and Arctic grayling that had been previously stocked in several Matanuska-Susitna Valley lakes (Figure 1). In August 1985, hatchery-reared rainbow trout fingerlings of Swanson River and Big Lake origin were stocked in Ravine, Reed, Tigger, and Walby Lakes at densities of approximately 200 fish per surface acre. In September 1986, Barley, Dawn, Kalmbach, and Marion Lakes were stocked with equal numbers of rainbow trout fingerlings of Swanson River and Big Lake origin at densities ranging from 208 to 280 fish per surface acre. When two strains of trout were planted in a lake, the trout of Swanson River origin were marked with a left ventral fin clip whereas the trout of Big Lake origin received a right ventral fin clip. In September 1986, "X" Lake was stocked with rainbow trout fingerlings of Swanson River origin and "Y" Lake was stocked with rainbow trout fingerlings of Big Lake origin at approximately 200 fish per surface acre.

Several lakes lack developed vehicle access which prohibits the direct release of hatchery-reared fish. Fish planted in some of these lakes are transported in buckets or bags injected with oxygen from the truck to the release site.

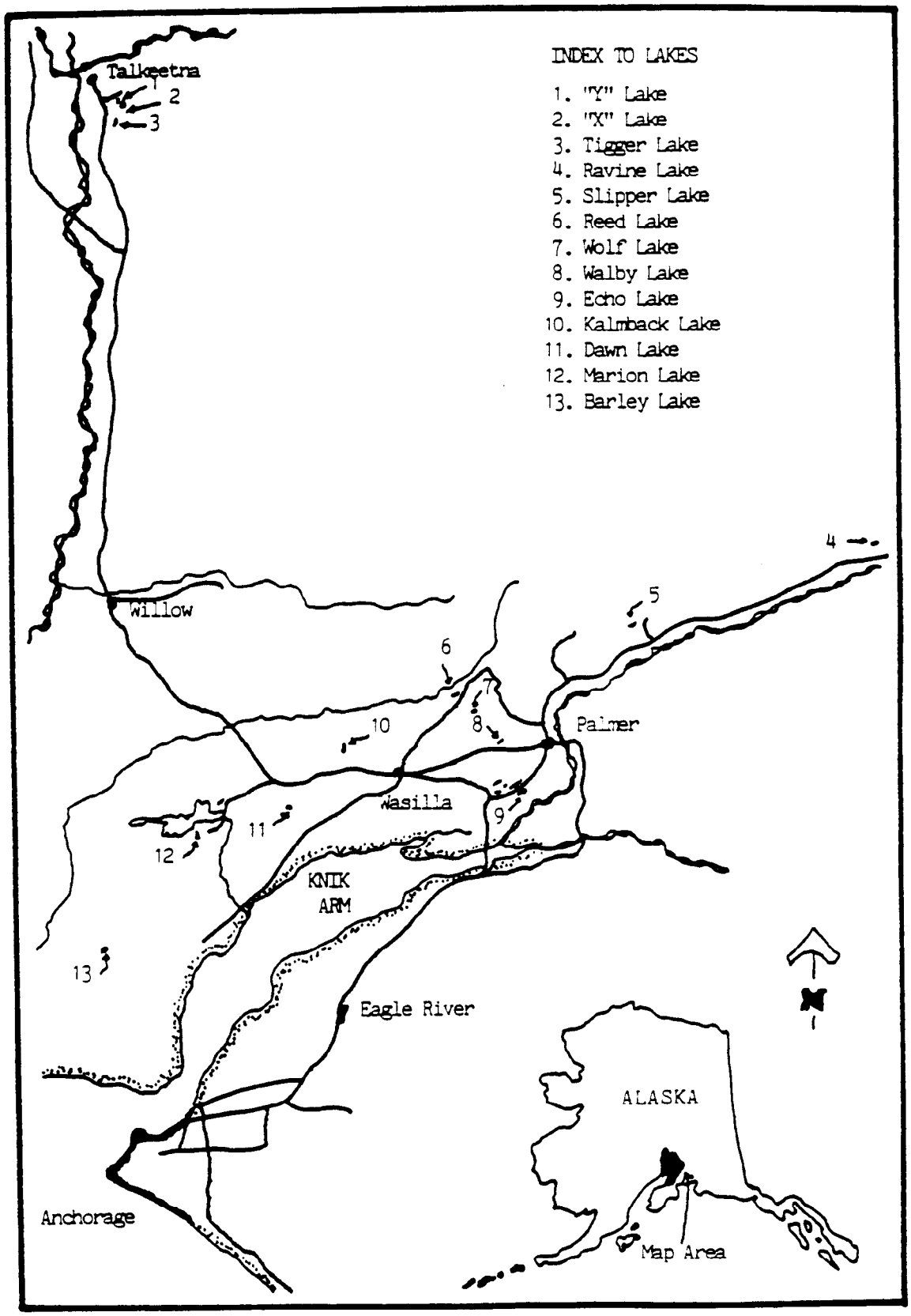

Figure 1. Sample lakes area of the Matanuska-Susitna Valley.

Other lakes require the use of all-terrain or four-wheel-drive vehicles, two to three people, and several hours of trip time to accomplish a planting. Some lakes require the use of airplanes to transport and drop the fingerlings.

An experiment was undertaken to compare the relative survival of rainbow trout released directly from a hatchery truck to that of rainbow trout dropped into the lake from an airplane. A Cessna 188 Agtruck equipped with a 1,090 liter fiberglass tank and a 24-volt compressor was contracted to air-drop rainbow trout fingerlings into several lakes during 1986. On 11 September 1986, 5,154 rainbow trout fingerings of Swanson River origin were marked with a left ventral fin clip and released directly into South Rolly Lake from a hatchery truck. Within an hour, 5,631 unmarked rainbow trout fingerlings of Swanson River origin were air-dropped from the Cessna at an altitude of approximately 100 m at an air speed of 85 to 90 knots.

Most Matanuska-Susitna Valley stocked landlocked lakes are planted with one species of game fish but may be capable of supporting harvestable numbers of more than one species to provide a diversity of fishing opportunity. For example, 13 Matanuska-Susitna Valley landlocked lakes are stocked annually with coho salmon fingerling; the salmon attain a maximum length of 365 mm (14 in) in most lakes, and mature and die in their third year. Introduction of rainbow trout biennially or triennially should provide anglers the opportunity to harvest coho salmon, and rainbow trout, which can live more than 6 years and attain weights over 2.27 kg (5 lb).

Increased availability of hatchery reared rainbow trout and Arctic grayling fingerling in 1986 made possible mixed species plants in several lakes. To develop stocking densities and ratios needed to maintain harvestable numbers, not necessarily equal numbers, of two species in landlocked lakes, three lakes were chosen for experiments to determine the survival and growth to age 1+ of game fish planted as fingerling. Echo Lake was stocked with coho salmon fingerlings at a density of 200 fish per surface acre in May 1986 and rainbow trout fingerlings of Swanson River origin at a density of 100 fish per surface acre in August 1986. Wolf Lake was stocked with coho salmon fingerlings at a density of 178 fish per surface acre in June 1986 and Arctic grayling fingerlings at a density of 169 fish per surface acre in September 1986. Slipper Lake was stocked with rainbow trout fingerlings of Swanson River origin at a density of 198 fish per surface acre and Arctic grayling fingerlings at a density of 220 fish per surface acre in September 1986.

Rainbow trout, coho salmon, and Arctic grayling were captured using fyke nets, gill nets, or both. The fyke nets were 2.7 m (9 ft) in length, 0.8 m (30 in) in diameter, and included two 0.9 m (3 ft) by 6.1 m (20 ft) wings, (two square aluminum frames and six steel or aluminum hoops supported the entrance and body of the fyke net). Internal throats, body, and wings were 4.8 mm (3/16 in) square mesh knotless nylon. Salmon eggs were used as bait in fyke nets. Gill nets were 36.6 m (120 ft) by 1.8 m (6 ft) variable mesh monofilament composed of six square mesh sizes, 12.7 mm (1/2 in), 15.9 mm (5/8 in), 19 mm (3/4 in), 25.4 mm (1 in), 38.1 mm (1-1/2 in), and 50.8 mm (2 in), each in a 6.1 m (20 ft) panel. Fyke nets were set parallel to the shoreline whereas gill nets were set at right angles to the shoreline. Both fyke nets

and gill nets were set in randomly selected sites and directions and fished for approximately 20 hours each.

Rainbow trout, coho salmon, and Arctic grayling captured in fyke nets were placed in a tub, oxygenated with a portable 7.5 kg (20 lb) oxygen bottle and anesthetized with equal parts of MS-222 and Quinate. The catch of each fyke net was then enumerated and placed in a 1.2 m (4 ft) by 1.2 m (4 ft) by 2.4 m (8 ft) covered holding pen made of plastic pipe covered by 4.8 mm (3/16 in) knotless nylon mesh. After all fish were in the holding pen, a minimum of 100 of each target strain or species were randomly selected and measured for fork length (FL) to the nearest millimeter. Age 1+ coho salmon and rainbow trout in Echo Lake, age 1+ coho salmon and Arctic grayling in Wolf Lake, and age 1+ rainbow trout and Arctic grayling in Slipper Lake were each given an adipose fin clip before being released. All other fish captured in fyke nets were released. All gill-netted fish were retained and measured to the nearest millimeter (FL).

A 2 by 2 chi-square contingency table was used to test the hypothesis of equal abundance of the two rainbow trout strains stocked at equal densities in Barley, Dawn, Kalmbach, and Marion Lakes. The rows were considered the treatment (rainbow trout strain). Column 1 was the number of fish recaptured for each group, and column 2 the number not recaptured of the total number stocked for each group. The students t-test was used to test if the mean lengths of the two stocking groups were significantly different. Necessary assumptions for the above analyses are:

1. both rainbow trout strains are equally susceptible to the capture gear;

2. the capture gear is randomly sampling both populations (i.e., if there are significant differences in length between the populations, the gear is not selective toward one population because of the difference in length); and,

3. for the t-test, the lengths are normally distributed random variables.

The abundance of age 1+ rainbow trout and Arctic grayling in Slipper Lake was estimated using the Petersen mark-recapture formula (Ricker 1975). Fish were captured for the estimate by fishing nine fyke nets for 3 nights then nine gill nets for 4 nights between 2 and 29 September.

The abundance of age 1+ coho salmon and rainbow trout in Echo Lake and age 1+ coho salmon and Arctic grayling in Wolf Lake was estimated using Chapman's modification of the Schnabel multiple census estimator (Ricker 1975). Fish were captured for the estimate in Echo Lake by fishing 15 fyke nets for 7 nights between 11 September and 9 October. In Wolf Lake, fish were captured for the estimate by fishing 15 fyke nets for 5 nights between 2 and 10 September.

RESULTS AND DISCUSSION

Abundance and Growth of Rainbow Trout

Rainbow trout of Swanson River origin had significantly ($P < 0.05$) higher survival than trout of Big Lake origin in Barley Lake ($\chi^2 = 54.36$); Dawn Lake ($\chi^2 = 9.50$); and Marion Lake ($\chi^2 = 162.89$). In Kalmbach Lake, however, there was not a significant ($P > 0.05$) difference between the abundance of rainbow trout of Swanson River and Big Lake origin ($\chi^2 = 2.24$). Mean lengths at age 1 of rainbow trout of each strain were similar within each lake except Kalmbach Lake where trout of Big Lake origin were significantly ($P < 0.05$) larger than those of Swanson River origin ($t = 3.86$ with degrees of freedom = 200). Mean lengths of rainbow trout of Swanson River origin ranged from 84 mm in Marion Lake to 103 mm in Barley Lake whereas mean lengths of trout of Big Lake origin ranged from 84 mm in Marion Lake to 102 mm in Barley Lake (Table 1).

There were no significant ($P > 0.05$) differences in mean lengths at age 2+ for rainbow trout of Swanson River and Big Lake origin within Ravine, Reed, Tigger, or Walby Lakes (Table 2). Mean lengths of trout of Swanson River origin ranged from 214 mm in Walby Lake to 312 mm in Reed Lake whereas mean lengths of trout of Big Lake origin ranged from 213 mm in Tigger Lake to 313 mm in Reed Lake.

There were no differences in size of rainbow trout of Swanson River and Big Lake origin in "X" and "Y" Lakes. Mean lengths of both age 1+ trout of Swanson River origin in "Y" Lake and age 1+ trout of Big Lake origin in "X" Lake were 114 mm (Table 3). In 1986 (Havens et al. 1987), mean length of age 1+ trout of Big Lake origin in "X" Lake was 113 mm whereas trout of Swanson River origin in "Y" Lake averaged 112 mm (Appendix Table 1).

The conclusion of 2 years of direct comparisons between rainbow trout of Swanson River and Big Lake origin indicate that although both strains demonstrate similar growth rates, the trout of Swanson River origin have higher survival. When both strains were stocked at equal densities in nine lakes, the trout of Swanson River origin had significantly ($P < 0.05$) higher survival in eight lakes; there was no significant difference in abundance between the two strains in Kalmbach Lake (Appendix Table 2). Overall, 9.6% of the trout of Swanson River origin that had been stocked in the nine lakes were recaptured at age 1 versus 5.8% recapture of the Big Lake trout.

There were no significant ($P > 0.05$) differences between the survivals of truck-released and air-dropped trout in South Rolly Lake ($\chi^2 = 2.68$). The mean length of air-dropped trout of Swanson River origin was similar to that of trout of Swanson River origin released directly from the hatchery truck (Table 4). These results are contrary to findings from a similar experiment conducted in Matanuska Lake (Havens, et. al. 1987) in which truck-released trout of Swanson River origin had significantly ($P < 0.05$) higher survival than air-dropped trout of Swanson River origin ($\chi^2 = 13.72$). We recommend that the air-drop stocking method should be continued for remote lakes. At a cost of $150/hour for the Cessna, several employee-days and hundreds of vehicle miles can be saved by air-dropping trout into lakes not directly accessible to hatchery tank trucks.

Table 1. Stocking history, fyke net catch summary, and length data for rainbow trout of Swanson River and Big Lake origin in Marion, Dawn, Kalmbach, and Barley Lakes, 1987.

Lake	Strain[1] (Clip)	Date Stocked	Number Stocked	Size Stocked	Date Captured	Number Captured	Length			
							Number Measured	Mean (mm)	Standard Error	Range (mm)
Marion	SR (LV)	09/9/86	13,319	2.01g	05/28/87	399	101	84	1.01	64-122
	BL (RV)	09/9/86	13,307	2.08g	05/28/87	113	101	84	0.87	67-108
Dawn[2]	SR (LV)	09/4/86	1,550	2.11g	05/29/87	301	101	96	1.27	69-128
	BL (RV)	09/4/86	1,550	2.06g	05/29/87	236	101	98	1.10	74-126
Kalmbach[2]	SR (LV)	09/8/86	13,013	1.90g	06/02/87	375	101	89	1.01	71-123
	BL (RV)	09/8/86	12,999	2.10g	06/02/87	416	101	96	1.12	70-121
Barley[2]	SR (LV)	09/4/86	2,600	2.11g	06/10/87	192	100	103	0.82	86-123
	BL (RV)	09/4/86	2,600	2.06g	06/10/87	74	71	102	1.02	84-127

[1] Strain (Clip): SR = Swanson River (LV) = left ventral clip
BL = Big Lake (RV) = right ventral clip.

[2] Dawn, Kalmbach, and Barley Lakes contain populations of threespine stickleback.

Table 2. Stocking history, net catch summary, and length data for age 2+ rainbow trout of Swanson River and Big Lake origin in Ravine, Reed, Tigger, and Walby Lakes, 1987.

Lake	Strain[1] (Clip)	Date Stocked	Number Stocked	Size Stocked	Date Captured	Number Captured	Length			
							Number Measured	Mean (mm)	Standard Error	Range (mm)
Ravine	SR (LV)	08/19/85	2,273	2.36g	07/21/87	48	48	241	3.53	196-312
	BL (RV)	08/19/85	2,270	2.60g	07/21/87	57	57	233	3.33	160-286
Reed	SR (LV)	08/21/85	4,092	2.36g	07/22/87	36	36	312	3.85	259-350
	BL (RV)	08/21/85	4,088	2.60g	07/22/87	22	22	313	4.42	265-348
Tigger[2]	SR (LV)	08/20/85	3,193	2.36g	07/29/87	41	41	221	5.02	162-281
	BL (RV)	08/20/85	3,193	2.60g	07/29/87	24	24	213	5.42	172-272
Walby[2]	SR (LV)	08/23/85	14,706	2.40g	07/23/87	40	40	214	7.07	136-325
	BL (RV)	08/23/85	14,607	2.10g	07/23/87	27	27	219	8.92	155-310

[1] Strain (Clip): SR = Swanson River (LV) = left ventral clip
BL = Big Lake (RV) = right ventral clip.

[2] Tigger and Walby Lakes contain populations of threespine stickleback.

Table 3. Stocking history, net catch summary, and length data for rainbow trout of Swanson River origin in "X" Lake, and Big Lake origin in "Y" Lake, 1987.

Lake	Strain[1]	Date Stocked	Number Stocked	Size Stocked	Date Captured	Number Captured	Catch per Net Hour: Fyke Nets	Catch per Net Hour: Gill Nets	Length: Number Measured	Length: Mean (mm)	Length: Standard Error	Length: Range (mm)
"X"[2]	SR	9/11/86	20,437	2.68g	07/16/87	337	3.86	1.28	337	114	0.58	77-138
"Y"[2]	BL	9/11/86	7,977	2.47g	07/16/87	22	0.35	0.10	22	114	2.24	84-131

[1] Strain: SR = Swanson River; BL = Big Lake.

[2] "X", and "Y" Lakes contain threespine stickleback.

Table 4. Comparison of hatchery truck and air-drop releases of rainbow trout of Swanson River origin in Matanuska Lake, 1986, and South Rolly Lake, 1987.

Lake	Stocking Method	Strain[1] (Clip)	Date Stocked	Number Stocked	Size Stocked	Date Captured	Number Captured	Length: Number Measured	Length: Mean (mm)	Length: St. Error	Length: Range (mm)
Matanuska	Truck	SR (AD)	9/04/85	9,550	2.20g	5/19/86	1,325	100	131	1.27	98-167
	Air-drop	SR (NM)	9/04/85	9,550	2.20g	5/19/86	1,153	100	132	1.38	103-168
South Rolly[2]	Truck	SR (AD)	9/11/86	5,155	2.72g	6/11/87	239	150	85	0.65	66-110
	Air-drop	SR (NM)	9/11/86	5,631	2.68g	6/11/87	225	146	88	0.95	60-115

[1] Strain (Clip): SR = Swanson River (LV) = left ventral clip
BL = Big Lake (RV) = right ventral clip.

[2] South Rolly Lake contains threespine stickleback.

Mixed Species

Coho salmon survival rate from a dual stocking with rainbow trout in Echo Lake was 13%. The survival rate for rainbow trout was 12% (Table 5). The mean length of age 1+ coho salmon in Echo Lake from a single species plant in 1983 was 246 mm; estimated survival was 2% (Havens, unpublished). The mean length of age 1+ coho salmon was 222 mm (1985) and 204 mm (1986) from stockings at equal densities with chinook salmon in 1984 and 1985, respectively (Havens, unpublished). In these three cases, the mean length of age 1+ coho salmon was greater than the mean length of 185 mm (Table 6) attained by the coho salmon stocked with rainbow trout in Echo Lake in 1986. Although it appears a dual plant of rainbow trout and coho salmon may limit first year fish growth, 80% of the coho salmon were larger than 165 mm and would be available for harvest in the winter ice-fishery. It is recommended that Echo Lake continue to be stocked annually with coho salmon at a density of 200 fish per surface acre and stocked with rainbow trout triennially at 100 fish per surface acre.

The mean length of age 1+ coho salmon in Wolf Lake was 161 mm (Table 6). The mean length of age 1+ coho salmon in Wolf Lake from the 1984 hatchery plant was 185 mm (Havens, unpublished). The mean length of Arctic grayling was 134 mm, with an estimated survival of 2.5% (Table 7). The mean length of age 1 Arctic grayling, stocked as 1.24 g fingerling in 1985, was 78 mm with an estimated survival of 1% (Havens, 1987). Judging from 2 consecutive years of poor Arctic grayling survival and growth, it is recommended that Arctic grayling plants be discontinued and Wolf Lake be stocked annually with coho salmon at a density of 200 fish per surface acre.

The mean length of age 1+ rainbow trout in Slipper Lake was 261 mm (Table 6), with an estimated survival of 6.2% (Table 8). The mean length of age 1+ rainbow trout in Slipper Lake from the first hatchery plant in 1983 was 143 mm with a gill net catch rate of 0.27 fish/hour (Havens, unpublished). No rainbow trout from either the 1983 or 1984 plant were captured in 1987. The estimated survival of Arctic grayling stocked in Slipper Lake was only 0.9% (Table 8). Due to the low estimated survivals of Arctic grayling and rainbow trout, it is recommended that fingerling plants be discontinued and Slipper Lake be stocked annually with 900 catchable rainbow trout to provide a lake fishery in the Sutton area.

Table 5. Schnabel population estimates of coho salmon and rainbow trout in Echo Lake, 1987.

Date of Estimation	Method of Capture	Target Species	Estimated Population	Estimated Survival	95% Confidence Interval	
					Population	Survival
09/11/87	Fyke Nets	Coho Salmon[1]	601	13.0%	509 - 709	11.0% - 15.4%
09/11/87	Fyke Nets	Rainbow Trout[2]	279	12.1%	250 - 311	10.9% - 13.5%

1 4,609 coho salmon at 3.54 g each were stocked on 05/23/86; 292 were captured, marked, and released during the population estimate.

2 2,300 rainbow trout at 2.96 g each were stocked on 08/27/86; 242 were captured, marked, and released during the population estimate.

Table 6. Stocking history, net catch summary, and length data for age 1+ coho salmon and rainbow trout in Echo Lake, coho salmon and Arctic grayling in Wolf Lake, and rainbow trout and Arctic grayling in Slipper Lake, 1987.

Lake	Species[1]	Date Stocked	Number Stocked	Size Stocked	Capture Dates	Number Captured	Length			
							Number Measured	Mean (mm)	Standard Error	Range (mm)
Echo[2]	SS	5/23/86	4,609	3.54g	09/11/87-	373	370	185	1.23	129-259
	RT	8/27/86	2,300	2.96g	10/09/87	273	266	165	1.88	108-249
Wolf[2]	SS	6/25/86	11,020	1.38g	09/02/87-	785	275	161	1.38	115-222
	GR	9/08/86	10,500	4.57g	09/10/87	217	119	134	1.88	80-189
Slipper	RT	9/10/86	1,800	2.34g	09/09/87-	59	57	261	5.17	178-331
	GR	9/22/86	2,000	6.38g	09/29/87	16	16	256	6.62	226-332

[1] Species: SS = coho salmon; RT = rainbow trout; GR = Arctic grayling.

[2] Echo and Wolf Lakes contain populations of threespine stickleback.

Table 7. Schnabel population estimates of coho salmon and Arctic grayling in Wolf Lake, 1987.

Date of Estimation	Method of Capture	Target Species	Estimated Population	Estimated Survival	95% Confidence Interval	
					Population	Survival
09/02/87	Fyke Nets	Coho Salmon[1]	1,095	9.9%	989-1,212	9.0%-11.0%
09/02/87	Fyke Nets	Arctic Grayling[2]	266	2.5%	226 - 313	2.2% - 3.0%

1 11,020 coho salmon at 1.38 g each were stocked on 06/25/86; 673 were captured, marked, and released during the population estimate.

2 10,500 Arctic grayling at 4.57 g each were stocked on 09/08/86; 200 were captured, marked, and released during the population estimate.

Table 8. Petersen population estimates of rainbow trout and Arctic grayling in Slipper Lake, 1987.

Date of Estimation	Method of Capture[1]	Target Species	Estimated Population	Estimated Survival	95% Confidence Interval	
					Population	Survival
09/02/87	FN and GN	Rainbow Trout[2]	112	6.2%	79 - 155	4.4% - 8.6%
09/02/87	FN and GN	Arctic Grayling[3]	18	0.9%	9 - 28	0.5% - 1.4%

[1] FN = fyke net; GN = gill net.

[2] 1,800 rainbow trout at 2.34 g each were stocked on 09/10/86; 37 were captured, marked, and released during the population estimate.

[3] 2,000 Arctic grayling at 6.38 g each were stocked on 09/22/86; 5 were captured, marked, and released during the population estimate.

LITERATURE CITED

Havens, A. C. 1987. Enhancement evaluation techniques for Arctic grayling in Alaska. Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1986-1987, Project F-10-2, 10(T-3-2): 1-19.

Havens, A. C., J. B. Murray, K. J. Delaney, and K. J. Roth. 1987. Evaluation of enhancement efforts for rainbow trout, coho salmon, and chinook salmon in southcentral Alaska. Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1986-1987, Project F-10-2, 33(T-3-2): 1-27.

Ricker, W. E. 1975. Computation and interpretation of biological statistics of fish populations. Bulletin of the Fisheries Research Board of Canada, 191: 382 p.

APPENDIX TABLES

Appendix Table 1. Stocking history, net catch summary, and length data for rainbow trout of Swanson River origin in Florence, Honeybee, "X", and "Y" Lakes and rainbow trout of Big Lake origin in Crystal, Lynne, "X", and "Y" Lakes, 1986-1987.

Lake	Strain[1]	Date Stocked	Number Stocked	Size Stocked	Date Captured	Number Captured	Catch per Net Hour: Fyke Nets	Catch per Net Hour: Gill Nets	Length: Number Measured	Length: Mean (mm)	Length: St. Error	Length: Range (mm)
Florence	SR	8/27/85	10,937	2.56g	7/16/86	422	6.39	4.55	422	119	0.42	85 - 131
Crystal[2]	BL	8/28/85	26,875	2.50g	7/16/86	235	3.26	0.46	235	102	0.84	66 - 134
Honeybee[2]	SR	8/27/85	11,603	2.56g	7/15/86	196	3.46	1.56	196	106	0.61	86 - 123
Lynne[2]	BL	8/28/85	14,000	2.50g	7/15/86	602	11.93	2.41	442	105	0.58	68 - 132
"Y"[2]	SR	8/27/85	8,003	2.56g	7/18/86	180	2.74	0.94	180	112	0.77	80 - 131
					7/16/87	22	0.20	0.24	22	193	3.93	145 - 212
	BL	9/11/86	7,977	2.47g	7/16/87	22	0.35	0.10	22	114	2.24	84 - 131
"X"[2]	BL	9/04/85	20,378	2.38g	7/18/86	276	3.32	1.30	276	113	0.69	84 - 134
					7/16/87	75	0.83	0.31	75	168	2.50	139 - 215
	SR	9/11/86	20,437	2.68g	7/16/87	337	3.86	1.28	337	114	0.58	77 - 138

[1] Strain: SR = Swanson River; BL = Big Lake.

[2] Crystal, Honeybee, Lynne, "Y", and "X" Lakes contain threespine stickleback.

Appendix Table 2. Stocking history, net catch summary, and length data for rainbow trout of Swanson River and Big Lake origin in Johnson, Ravine, Reed, Tigger, and Walby Lakes, 1986-1987 and in Marion, Dawn, Kalmbach, and Barley Lakes, 1987.

Lake	Strain[1] (Clip)	Date Stocked	Number Stocked	Size Stocked	Date Captured	Number Captured	Chi-Square Value[2]	Length Number Measured	Mean (mm)	St. Error	Range (mm)	t Value[3]
Ravine	SR(LV)	8/19/85	2,273	2.36g	06/11/86	398	χ^2= 58	100	108	1.11	82-135	t =3.6
	BL(RV)	8/19/85	2,270	2.60g	06/11/86	221	df=1	100	103	0.82	89-123	df=198
	SR(LV)	8/19/85			07/21/87	48		48	241	3.53	196-312	t =1.6
	BL(RV)	8/19/85			07/21/87	57		57	233	3.33	160-286	df=103
Reed	SR(LV)	8/21/85	4,092	2.36g	06/15/86	718	χ^2= 77	100	125	1.35	92-160	t =1.9
	BL(RV)	8/21/85	4,088	2.60g	06/15/86	441	df=1	100	121	1.09	95-152	df=198
	SR(LV)	8/21/85			07/22/87	36		36	312	3.85	259-350	t =0.1
	BL(RV)	8/21/85			07/22/87	22		22	313	4.42	265-348	df= 56
Tigger[4]	SR(LV)	8/20/85	3,193	2.36g	06/17/86	907	χ^2= 68	100	98	1.24	74-130	t =.02
	BL(RV)	8/20/85	3,195	2.60g	06/17/86	625	df=1	100	98	1.02	75-124	df=198
	SR(LV)	8/20/85			07/29/87	41		41	221	5.02	162-281	t =1.0
	BL(RV)	8/20/85			07/29/87	24		24	213	5.42	172-272	df= 63
Walby[4]	SR(LV)	8/23/85	14,706	2.40g	06/06/86	866	χ^2= 5	100	89	1.29	63-127	t =0.3
	BL(RV)	8/23/85	14,607	2.10g	06/06/86	775	df=1	100	90	1.25	67-116	df=198
	SR(LV)	8/23/85			07/23/87	40		40	214	7.07	136-325	t =0.5
	BL(RV)	8/23/85			07/23/87	27		27	219	8.92	155-310	df= 65
Johnson	SR(LV)	9/03/86	4,030	2.56g	10/23/86	1,500	χ^2=751	106	78	0.60	65- 91	t =4.0
	BL(RV)	9/03/86	4,030	2.06g	10/23/86	477	df=1	102	75	0.48	63- 86	df=206
	SR(LV)	9/03/86			10/13/87	174		31	242	3.63	193-270	t =3.1
	BL(RV)	9/03/86			10/13/87	63		27	224	4.23	169-272	df= 56
Marion	SR(LV)	9/09/86	13,319	2.01g	05/28/87	399	χ^2=163	101	84	1.01	64-122	t =0.3
	BL(RV)	9/09/86	13,307	2.08g	05/28/87	113	df=1	101	84	0.87	67-108	df=200
Dawn[4]	SR(LV)	9/04/86	1,550	2.11g	05/29/87	301	χ^2= 10	101	96	1.27	69-128	t =1.6
	BL(RV)	9/04/86	1,550	2.06g	05/29/87	236	df=1	101	98	1.10	74-126	df=200
Kalmbach[4]	SR(LV)	9/08/86	13,013	1.90g	06/02/87	375	χ^2= 2	101	89	1.01	71-123	t =3.9
	BL(RV)	9/08/86	12,999	2.10g	06/02/87	416	df=1	101	96	1.12	70-121	df=200
Barley[4]	SR(LV)	9/04/86	2,600	2.11g	06/10/87	192	χ^2= 54	100	103	0.82	86-123	t =0.3
	BL(RV)	9/04/86	2,600	2.06g	06/10/87	74	df=1	71	102	1.02	84-127	df=169

1 Strain (Clip): SR = Swanson River (LV) = left ventral clip
BL = Big Lake (RV) = right ventral clip.

2 Chi-square test for statistically significant difference between catch (abundance or relative survival) of Swanson River and Big Lake strain rainbow trout; Table value at df = 1 is 3.84146 so there was a significant difference ($p < 0.05$) between both strains in all lakes except Kalmbach Lake. [Swanson River dominated in all cases except Kalmbach Lake].

3 T-Test for statistically significant difference between mean length of Swanson River and Big Lake strain rainbow trout; the only significant difference ($p < 0.05$) in mean lengths was in Ravine, Johnson and Kalmbach Lakes. [Swanson River trout were larger in Ravine and Johnson Lakes and Big Lake trout were larger in Kalmbach Lake].

4 Tigger, Walby, Dawn, Kalmbach and Barley Lakes contain populations of threespine stickleback.

Appendix Table 3. Fyke net capture summary for coho salmon and rainbow trout in Echo Lake, 1987.

	Coho Salmon				Rainbow Trout			
Capture Date	Number Captured	Number Recaptured	Number Marked	Marked Fish At Large	Number Captured	Number Recaptured	Number Marked	Marked Fish At Large
09/11/87	43		43	0	46		46	0
09/15/87	36	4	32	43	129	23	101	46
09/16/87	24	2	22	75	86	55	31	147
09/17/87	27	4	23	97	69	45	24	178
09/18/87	44	4	40	120	91	67	24	202
09/29/87	203	49	132	160	80	63	16	226
10/09/87	132	73		292	95	70		242
Totals	509	136	292		596	323	242	

Appendix Table 4. Fyke net capture summary for coho salmon and Arctic grayling in Wolf Lake, 1987.

	Coho Salmon				Arctic Grayling			
Capture Date	Number Captured	Number Recaptured	Number Marked	Marked Fish At Large	Number Captured	Number Recaptured	Number Marked	Marked Fish At Large
09/02/87	247		247	0	94		94	0
09/03/87	78	8	70	247	68	30	38	94
09/04/87	104	32	72	317	34	20	14	132
09/09/87	477	193	284	389	100	46	54	146
09/10/87	247	135		673	63	46		200
Totals:	1,153	368	673		359	142	200	

Appendix Table 5. Gill net capture summary for rainbow trout and Arctic grayling in Slipper Lake, 1987.

	Rainbow Trout		Arctic Grayling	
Capture Date	Number Captured	Marked Recaptures[1]	Number Captured	Marked Recaptures[2]
09/09/87	42	14	5	1
09/10/87	21	7	6	1
09/11/87	14	6	2	0
09/29/87	10	1	8	3
Totals:	87	28	21	5

[1] Thirty-seven rainbow trout were captured, marked, and released between 09/02/87 and 09/04/87.

[2] Five Arctic grayling were captured, marked, and released between 09/02/87 and 09/04/87.